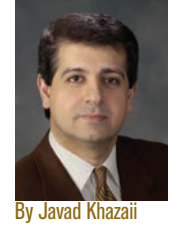

By Javad Khazaii

Rethinking Energy Modeling

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Uncertainty analysis is the process of changing simulation model input parameters in a small margin of possible occurrences and observing how simulation output can be affected (output probability distribution). That is the basic difference between a deterministic simulation and a probabilistic (uncertain) simulation. Uncertainty analysis is a strong tool for modelers and those who use modeling results to make well-informed decisions.

ASHRAE Standard 90.1, Appendix G, requires the energy modeler to perform two sets of deterministic energy modeling processes for two generally similar buildings to compare their yearly energy consumption (cost) and to show that the design building performs better than the base building from an energy consumption (cost) standpoint.

Although the design and base buildings are completely similar in basic physical shape and size, many dissimilarities exist, such as size and heating characteristics of the glazing, heating characteristics of other envelope elements, lighting density, and type of HVAC system.

However, these are not the main differences between the buildings. The real difference is that the design building almost certainly will be built, and the base building is just an imaginary building. So the question arises: is it correct to compare real building energy performance with that of an imaginary building?

After a design building is constructed, it is implied that every element used in its construction may have characteristics that slightly deviate from the design. These deviations are generated based on the testing agencies allowed tolerances for manufacturing or building that element.

For example, when a concrete block with a u-value of x is used as the design building modeling input, and the manufacturing tolerance for the concrete block is $\pm y\%$, what is actually used in construction has a u-value of $x \pm y\%$. Research has shown that when we consider the uncertainty that arises from these deviations, it changes the energy model result considerably. It has been shown that existence of these types of deviations in the building envelope can cause the energy modeling to be off by up to 15% from the deterministic modeling output.

Other uncertainties, such the variations of energy consumption of HVAC equipment due to allowed manufacturing tolerances, also are a source of deviation of the real building performance from the deterministic modeling output.

The results of a deterministic simulation cannot express completely the real building consumption (cost). But, because the base building is imaginary, it is not subjected to the uncertainties that come with the real construction and is modeled completely in a deterministic way.

Energy modeling software that compares design and base buildings needs to be revised so that it can allocate uncertainties to the inputs of the design building and present a probabilistic output. Then, it should compare these probabilistic results with the outputs of the base building that will be performed using the traditional deterministic simulation method. ■

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